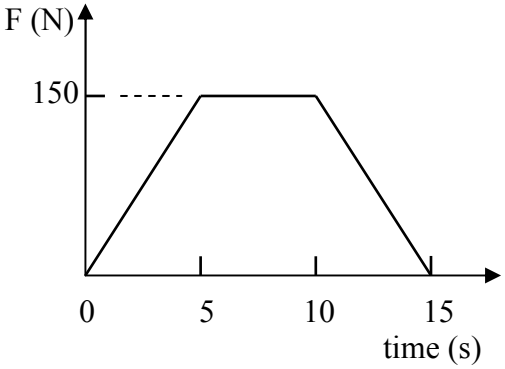
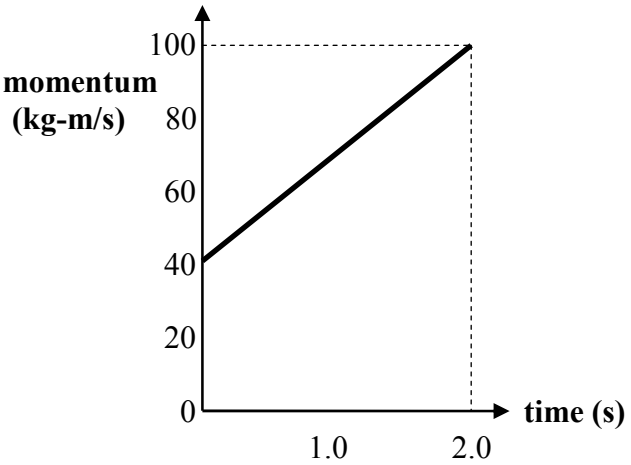
PHYSICS 12 IMPULSE & MOMENTUM WORKSHEET 1

1. A 75 kg cart that is travelling at a constant speed has a force applied to it which brings the cart to a stop in 15 s. A Force vs. Time graph of this event is shown to the right:



   a) What impulse was delivered to the cart?
   b) At what speed was the cart moving when the force was applied?
   c) If the applied force was reduced by 1/3 for the duration of the event, how much time would be taken to bring the cart to a stop?

2. The motion of another cart of mass 25 kg is depicted in a momentum-time graph.



   a) Determine the impulse delivered to the 40 kg cart.
   b) What overall force acted on the cart?
   c) What was the change in velocity of the cart?

3. A 3.8 kg object was accelerated from 12 m/s to 19 m/s by a force of 16 N.
   a) What impulse acted on the object?
   b) How long did the force act?

4. A sandbag stops a 0.012 kg bullet which was travelling at 860 m/s. The bullet penetrated a distance of 0.24 m into the sand.
   a) What was the original momentum of the bullet?
   b) How long did it take to stop the bullet?
   c) What average force acted on the bullet?

5. A smallish physics student of mass 36.0 kg slides across smooth ice at 6.80 m/s. She then slides onto rough ice for 2.40 s, changing her velocity to 2.20 m/s.
   a) What is the momentum of the student as she slides across the smooth ice?
   b) What is the size and direction of the force acting on the student after hitting the rough ice?

6. A 45 kg crash test dummie travels without a seat belt in a test car at 16 m/s. When the car is deliberately run into a wall, the dummie is stopped by the windshield in a distance of 0.024 m.
   a) How much time is taken for the dummie to stop?
   b) What force does the windshield exert on the dummie?
   c) The identical test is performed on a second dummie (same mass), but with a seat belt fastened that causes this dummie to stop (without hitting the windshield) in a distance of 0.68 m. What force acts on this second dummie?
   d) What is the ratio of force found in (b) to that found in (c)?

7. A 60 g bullet is fired from a 5.0 kg gun with a speed of 600 m/s. Find the gun's recoil speed.

8. If a 1.0 kg ball travelling south at 7.0 m/s collides with a 2.0 kg ball travelling in the same direction at 3.0 m/s, the velocity of the 2.0 kg ball is increased to 4.5 m/s in the original direction. What happens to the 1.0 kg ball?

9. A mini car of mass 600 kg is involved in a head-on collision with a 3000 kg truck travelling at 15 m/s towards it. The mini is thrown onto the hood of the truck (don't ask how) which continues on at 5.0 m/s in the original direction. How fast was the mini moving?

10. A proton (mass = 1.67×10^{-27} kg) travelling at 10^7 m/s collides with a stationary particle and bounces back at 6.0×10^6 m/s. If the particle moves forward at 4.0×10^6 m/s, what is its mass?

11. A small car, mass 500 kg, fails to stop at a 'T' junction until it is in the middle of the road. It is then struck by a 1000 kg sports car, with the two cars locking together. The skid marks stretch for 40 m. Assuming that the frictional force on the two vehicles was a constant 7.5×10^3 N, find:
    a) the acceleration of the wreckage. (Hint: the net force *after* the collision = ?)
    b) the speed of the two cars <u>just</u> after impact.
    c) the speed of the sports car <u>just</u> before impact.

1. a) 1500 N•s b) 20 m/s c) 45 s 2. a) 60 N•s b) 30 N c) 2.4 m/s 3. a) 27 N•s b) 1.7 s 4. a) 10 kg•m/s b) 5.6×10^{-4} s c) 1.8×10^4 N 5. a) 245 kg•m/s b) 69 N backwards 6. a) 0.0030 s b) 2.4×10^5 N c) 8470 N d) about 28:1 7. 7.2 m/s 8. vel. reduces to 4.0 m/s <u>south</u> 9. 45 m/s 10. 6.68×10^{-27} kg 11. a) -5.0 m/s^2 b) 20 m/s c) 30 m/s